

MAJOR OAK DISEASES AND THEIR CONTROL



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MAJOR OAK DISEASES AND THEIR CONTROL

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Oaks represent the major shade trees of Texas and are also important components of forests and rangelands. They are normally long-lived, possess the ability to withstand adverse weather and have been considered disease resistant. During the drought in the mid 1950s large expanses of oak trees began dying in the Texas Hill Country. Since then oak mortality has become a serious problem in many areas where oaks are the predominant native tree species. Research shows that much of this mortality is due to disease-causing organisms or disease complexes involving environmental stress and pathogens.

FOLIAR DISEASES

Anthracnose (Fungus - *Gnomonia* sp.)

All oaks are susceptible; however, post oak appears to be the most vulnerable. Symptoms of anthracnose include small irregular spots formed along the leaf margin or leaf veins. During periods of severe infection premature defoliation may occur. Anthracnose rarely kills, but trees severely defoliated annually become weakened.

The fungus overwinters in infected leaves. In the spring airborne fungal spores are produced which infect developing leaves. Soon after infection, leaves become necrotic and secondary spore production occurs. This cycle may continue as long as weather conditions favor fungal development. Damage from this disease is most severe when light rain or dew occurs during budbreak and leaf expansion.

Sanitation is necessary in controlling anthracnose since the pathogen survives from year to year in fallen leaves. Rake leaves when they fall rather than waiting for full leaf drop. Destroy leaves from diseased trees or place in a compost pile to undergo heating to kill the fungus. A protective fungicide

such as a copper, zineb, maneb or a benomyl-containing fungicide may be required if damage persists. Apply necessary sprays in the spring during leaf emergence and repeat in 7 to 14 days as needed.

Oak Leaf Blister (Fungus - *Taphrina caerulescens*)

Water oak, post oak, red oak and live oak are most often infected with the oak leaf blister fungus. Of these, water oak is the most susceptible.

Leaves infected with the fungus have a distinct bulge on the leaf's surface. The surface opposite the bulge has a light green-to-olive, velvety fungal growth. With age this growth becomes dark brown-to-black in color. The raised area on the leaf is first light green but turns brown with age. The remainder of the leaf retains a green color. Little defoliation occurs unless infection is extensive.

The fungus overwinters on bud scales. In the spring as buds begin to open, overwintering fungal spores germinate during favorable weather and infect developing leaves. Mild temperatures and light rain or dew during bud opening are necessary for infection to occur.

Chemical control of oak leaf blister is not often suggested except for very susceptible and valuable



Water oak leaves infected with the oak leaf blister fungus.

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Powdery mildew on live oak leaves.

trees growing in humid areas. Treat trees which have a history of severe damage from oak leaf blister with a copper-containing fungicide in the spring just before bud opening. Fungicides applied after infection occurs are not effective.

Powdery Mildew (Fungus - *Phyllactinia corylea* and others)

All species of oaks are susceptible but some are more prone to extensive damage than others. Powdery mildew on live oaks is first visible as faint yellow spots on the upper and lower surfaces of the leaves during the latter part of summer. Spots are normally round and approximately $\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter. Premature defoliation occurs with severe infection. Usually, however, leaves are retained until normal leaf shed. In the case of other oaks, powdery mildew may cover the entire leaf surface giving the appearance of a fine white to gray powder.

The fungus overwinters on infected leaves in a spore stage which is resistant to adverse weather conditions. In the spring and summer fungal spores are carried by air currents to infect leaves of healthy trees. Fungal structures develop only in and on the outer layer of leaf cells.

Sanitation is important in controlling powdery mildew since initial inoculum comes from leaves infected the previous year. Rake and discard fallen leaves in a compost pile where they can undergo complete decay.

Applying a benomyl-containing fungicide keeps high value trees free of the fungus. Use a wetting agent with the fungicide to improve coverage of the waxy leaf surface.

Actinopelte Leafspot (Fungus - *Actinopelte dryina*)

All species of oaks are susceptible, but young red oak trees are the most severely damaged. Small, distinct reddish brown spots form on diseased leaves. The fungus is a primary pathogen but is most often



Endothia canker on red oak resulting from fungus invasion of a pruning cut.

found on leaves infected with other pathogens. It may cause large brown spots on the leaf margin. Premature defoliation occurs when infection is severe.

The fungus overwinters in fallen leaves. Spores are moved in the spring by air currents to healthy foliage where infection occurs. In most areas, symptoms are observed around midsummer and during the fall. Newly planted trees or those weakened from other causes appear to be the most severely damaged.

To prevent damage, water and fertilize trees properly. This includes furnishing iron to Texas red oaks that develop chlorosis. Trees deficient in iron are under stress and are more susceptible to many foliage pathogens. Rake and destroy fallen leaves and use copper, maneb, zineb or benomyl-containing fungicides when needed.

DISEASES OF LIMBS AND TRUNKS (CANKERS)

Endothia Canker (Fungus - *Endothia gyrosa*)

Most oak species are susceptible. Endothia cankers usually are associated with pruning cuts or other wounds and appear as sunken areas on limbs, trunk and roots of trees. Bright orange pustules $\frac{1}{16}$ to $\frac{1}{8}$ inch in height and approximately $\frac{1}{8}$ inch in diameter



Early stage of Hypoxylon canker development on live oak.

are present over the surface of the canker. Cankers generally are elongated in shape and may extend for several inches.

The fungus is most damaging on trees that are in a weakened condition. Stress induced by drought, low fertility or mechanical damage predisposes trees to damage from the fungus. Trees growing vigorously are generally resistant to infection. A general maintenance program is important in preventing this problem. Prune when trees are dormant and the fungus is less active, reducing the chance of infection. When circumstances require pruning during the growing season, apply wound paints to freshly cut surfaces to prevent the fungus from coming in contact with exposed wood. Wound paints are not effective in inhibiting organisms that cause discoloration and decay. Remove limbs infected with *Endothia*. Fungicide sprays are ineffective in controlling this pathogen.

Hypoxylon Canker (Fungus - *Hypoxylon atropunctatum*)

All oak species are susceptible with water oaks and post oaks being among the most susceptible.

Trees with Hypoxylon canker first appear chlorotic and develop thin foliage. In severe cases leaves die quickly and turn a light brown. They may cling to the tree for a short time. Soon after foliar symptoms develop fungal structures may be observed on limbs and trunks. The rough, outer bark separates from the limb and trunk. On the wood where the bark sloughs, a reddish brown to olive green spore material with a dusty appearance forms. Soon thereafter a dark brown to black crusty material forms. The color of this material varies with the species. On post oak the fungus is a dark brown while on the water oak the area appears as light reddish brown. This stage of the fungus lasts 6 to 12 months and then the area develops a gray appearance. Wood from trees that have died from Hypoxylon canker is lighter weight due to the rapid decaying action of the fungus.



Continued development of Hypoxylon canker.



Final stage of Hypoxylon canker development.

Trees die from Hypoxylon canker in a random pattern with no movement of the fungus from one tree to another through rootgrafts. Hypoxylon canker is most often associated with trees that are under environmental stress such as drought or mechanical damage. The fungus often infects Texas red oaks and live oaks that have been infected with the oak wilt fungus. Wind and insects are suspected of spreading the fungus spores.

Good care is the most effective means of preventing the onset and development of disease. Deep

watering during July, August and September is important in preventing moisture stress. Do not store wood from infected trees near healthy trees. If the fungus occurs on a scaffold limb, remove the limb to stop pathogen development. Make cuts 24 to 36 inches below the visible damage to minimize the chance that the fungus has developed beyond the point of the cut. The effectiveness of pruning is determined by early detection of infection and pruning well in advance of the fungus. Treat cut areas with a protective wound paint after pruning. Be sure to sterilize all pruning equipment before and after working on diseased trees. A dip of 1 part household bleach and 9 parts water will destroy the pathogen. Lightly oil all metal parts when completing the project to prevent damage to the equipment.

Heart Rot (Fungi - Several different species, including *Polyporus* spp., *Poria* spp., *Hericium* sp., *Sterium* spp.)

Heartwood of any oak species may be invaded by one or more of the fungi mentioned above. These fungi are most damaging to older, mature trees that have been exposed to wounds, resulting from wind, ice, mechanical injury and insects. Heart rots may occur at the base of the tree or may extend into the trunk and larger branches.

Tissue damaged by fire, construction equipment, wind and ice creates an ideal infection site for heart rot fungi. Following wounding, bacteria and non-decay fungi first invade and discolor the wood. Decay fungi then invade and destroy the inner portion of the tree. Injured trees may continue to be invaded by heart rot fungi. These fungi eventually form conks on the tree surface that produce spores having the ability to cause new infections on additional trees.

Heart rot is best controlled by preventing major wounds and using prescribed pruning techniques. If a tree is wounded, maintain it in good health so that the wound calluses rapidly. Commercial wound paints are not effective in preventing invasion of heart rot fungi. If heart rot is extensive and the tree is structurally unsound it should be removed. Filling cavities may lead to further decay if not done properly.

VASCULAR DISEASES

Oak Wilt (Fungus - *Ceratocystis fagacearum*)

All species of oaks are susceptible; however, Texas red oak and live oaks in the Hill Country and South Central areas are the most commonly affected. Post oak is rarely affected. The foliage of infected Texas red oaks turns pale green, then yellow and finally brown. Texas red oaks generally die within 7 to 30 days after the first disease symptom. Leaves turn

brown and remain on the tree for weeks. Sucker sprouts often form on the dying trunks, but a diseased tree rarely survives more than one season. Most live oaks die within 60 days to 2 years after initial infection is observed. Some live oaks, however, survive for several years after infection. Weakened trees may be colonized by other fungi such as *Hypoxylon* sp. and *Cephalosporium* sp.

A common symptom of oak wilt on live oak is flagging or browning of leaves on individual limbs during spring months. Later in the year, leaves on infected limbs exhibit more specific patterns of chlorosis and necrosis. The most characteristic leaf symptom is dead tissue along the veins and tip of the leaf. Both symptoms can occur on the same tree and in some cases on the same leaf. Defoliation occurs quickly after symptoms are observed. It is common to see complete defoliation within 30 days after infection. Symptom development is most rapid during spring and fall.

The fungus spreads locally from tree to tree through rootgrafts and common root systems. The disease cycle as it occurs in Texas is shown in figure 1. Insects spread it over long distances, depending on the formation of fungal mats beneath the bark of Texas red oaks (Spanish oaks). These mats form under cool, moist conditions and push bark away from the wood. The sweet odor of the fungal mat attracts insects. Spores are carried on the bodies of insects from mats to wounds and pruning cuts on healthy trees. Mat formation on Texas red oak is most active during March, April, May, June, October and November. Oak wilt mats have not been observed on species other than Texas red oak. Firewood also plays an important role in the spread of the fungus, in that it may harbor insects that emerge and transport spores.

Control of oak wilt is difficult with no one method proving effective in all cases. The oak wilt fungus usually radiates rapidly once established in an individual tree or motte of live oaks. Stopping the spread of fungus from the infection center should therefore be the first objective. In stands of infected oaks, mechanically sever common root systems with a ditching machine or trencher or chemically with the soil fumigant Vapam. It is important when cutting roots that the trench be deep enough to sever all existing roots. In some areas this may be difficult because of rock layers under the soil surface. In figure 2, the suggested location for a trench is described in detail. Remove all trees on the disease side of the trench, including a band of symptomless trees. These trees may be infected and if left in place may serve as the source of inoculum for a new infection center. Trenching is most effective when done in an area where well defined oak wilt centers are widely separated and the soil is not underlain with rock. If Texas red oak is a major species in the tree popula-

Oak Wilt Disease Cycle in Texas

Caused by *Ceratocystis fagacearum*

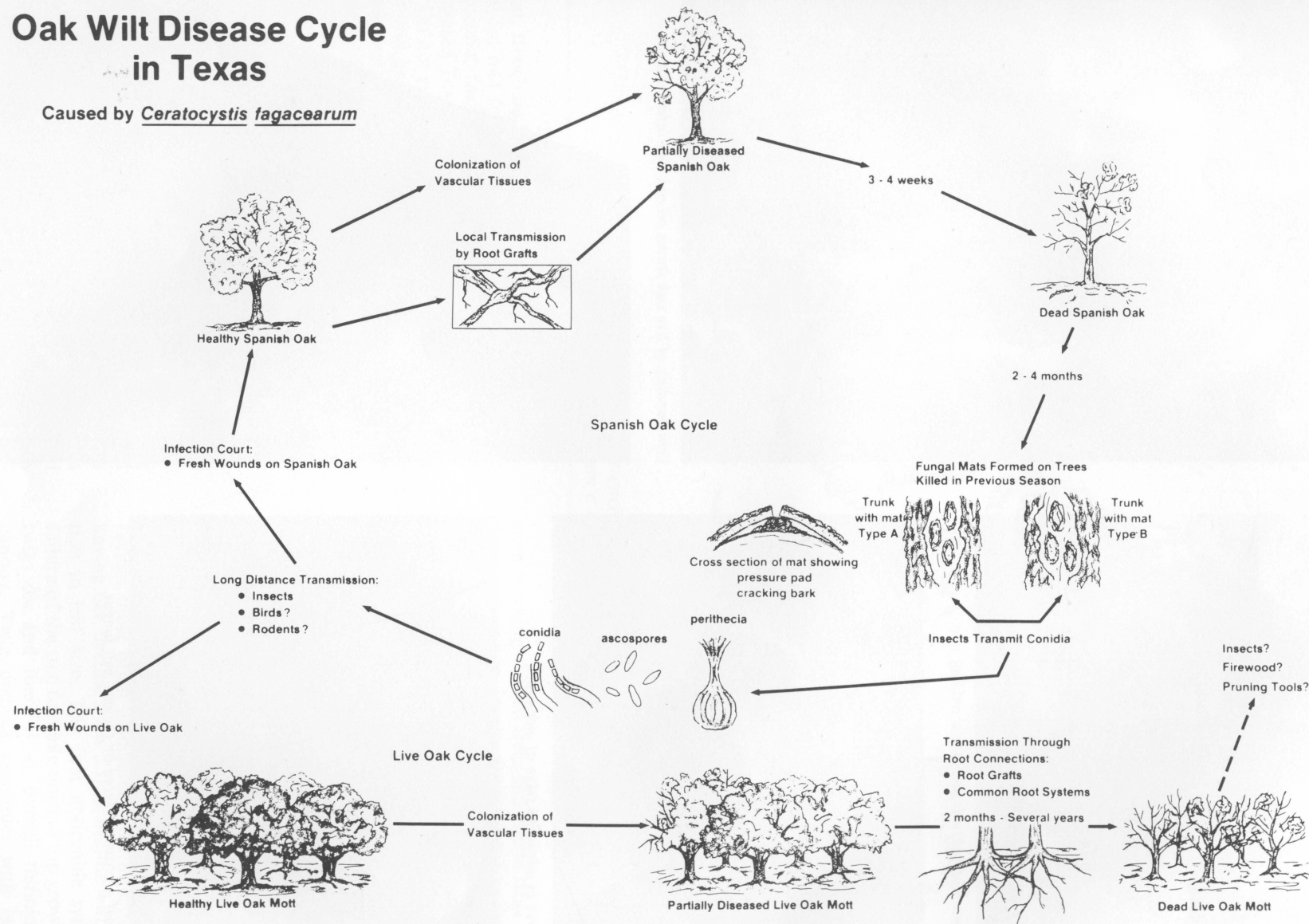
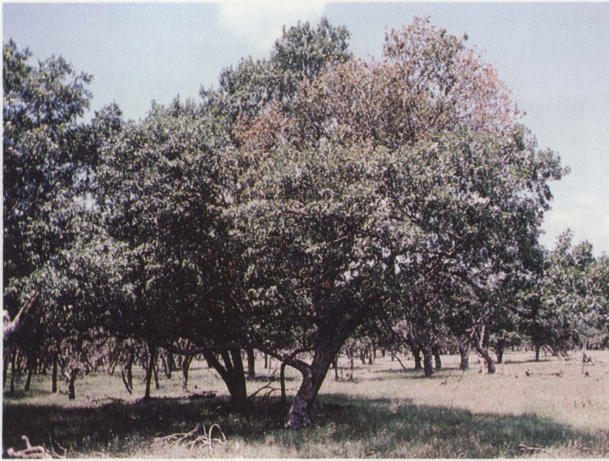


Figure 1. Oak wilt disease cycle.



First symptom of oak wilt invading a red oak tree.



Live oak tree in advanced stage of oak wilt.



Marginal leaf necrosis induced by the oak wilt fungus.



Vein banding of live oak leaves on oak wilt infested trees.



Oak wilt canker on a dead red oak tree.

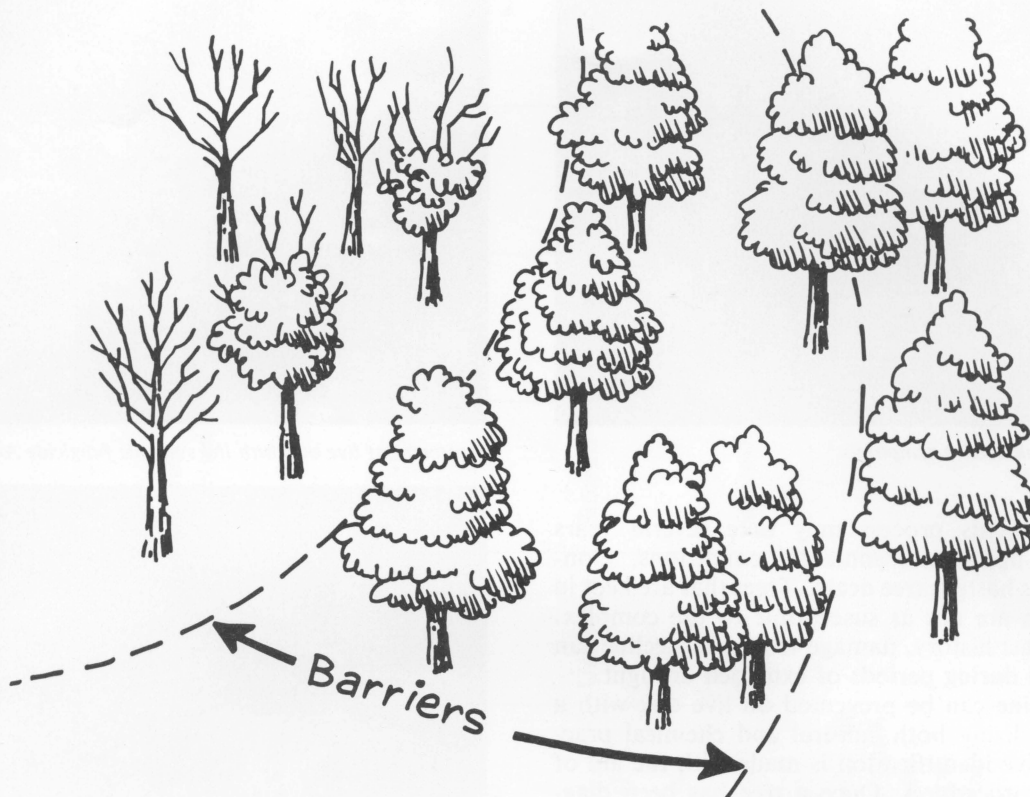


Figure 2. Location of trenches to slow development of the oak wilt fungus from a centralized infection center.

tion, trenching is less effective because of the potential for mat formation and insect spread. Where the potential for oak wilt is high, remove and destroy diseased Texas red oaks.

Do not store wood removed from oak wilt centers around healthy trees. If the wood is for firewood, cover with clear plastic to prevent the emergence of insects. It is necessary to use clear plastic so that insects are trapped and killed by the heating effect of the sunlight through the plastic. Unlike black plastic, clear plastic will not reveal exit holes to trapped insects. Immediately destroy wood not used for firewood.

Prune in oak wilt areas during December, January, February and March. Pruning cuts made during fungal mat development may attract insects emerging from diseased trees. If trees are pruned during months of fungal activity, paint cuts with a wound paint to prevent insects from coming in contact with the fresh wounds. Pruning during high risk months should only be done to repair storm or mechanical damage. Landowners should be especially cautious for 2 to 3 years following a disaster such as a tornado, hurricane, severe hail or following a period of mechanical activity around oak trees. Heavy equip-

ment working around trees can create large wounds. When this occurs, insects are attracted to the site and may be carrying the wilt pathogen. Be prepared to clean an infection site as soon as it appears. Quick action reduces the number of trees eventually lost to the fungus.

Currently no chemical treatment is recommended for control of the oak wilt fungus.

Oak Decline (Complex involving stress factors and fungi. Although several fungi have been associated with the complex, presently *Cephalosporium diospyri* is the only fungus shown to produce decline symptoms in live oaks.

Oak decline is a disease complex affecting trees under stress. In Texas, drought and urban stress are factors most often associated with infection. Trees having oak decline show a slow decline with a reduction in leaf size. The first noticeable symptom is failure of the tree to make normal top growth. Small twigs die and there is an overall thinning of the canopy. Twig dieback continues with larger and larger limbs being killed. Eventually the only limbs alive are main scaffold limbs covered with small tufts



Typical live oak decline symptoms.

of growth. This process may take several years depending upon environmental conditions. Continued stress hastens tree death. Trees that are kept in good health are not as susceptible to the complex. Based on past history, damage from oak decline can be expected during periods of extended drought.

Oak decline can be prevented on live oak with a program utilizing both cultural and chemical practices. Positive identification is made with the aid of laboratory procedures. Once a tree has been diagnosed as having oak decline, follow a complete maintenance program involving fertilizer applications, deep watering during summer months, pruning and removal of dead or weak limbs. Treat trees in early stages of decline); destroy ones having no chance of recovery. Treat valuable trees with the systemic fungicide, Arbotect, sometime between June and October. Repeat treatment the following summer.

Arbotect is effective in reducing symptoms of oak decline. It is administered by injection under pressure into the base of the tree. While specialized equipment is required, it is relatively inexpensive and easy to use. Arbotect is injected into the tree as close to the soil line as possible. For further information see product label.

MISCELLANEOUS PROBLEMS

Mistletoe (Parasitic plant - *Phoradendron* sp.)

Mistletoe is a parasitic plant that feeds in the vascular system of the host tree through specialized structures called haustoria. The visible portion of mistletoe is a leafy, evergreen plant that grows in bunches on limbs of the host tree. Leaves are thick and waxy and female plants produce white berries. Birds spread seed to other trees where new plants form.



Treatment of live oak with the systemic fungicide Arbotect.



Mistletoe on pin oak tree.



Ball moss development on post oak limbs.

The only control for mistletoe is to surgically remove the mistletoe plant and its attachment point. On small limbs make cuts 10 to 12 inches below the point of attachment. On larger limbs remove a

Table 1. Summary of three major diseases of oak trees in Texas.

Disease	Principal trees affected	Leaf Symptoms		Rate of death	Spreads through rootgrafts	Trees affected	Control Measures		
		Characteristic symptoms	Shedding				Isolation	Chemical	Cultural
Oak wilt	Texas red oak and live oak	Chlorosis and necrosis along veins with marginal necrosis on some leaves	Yes	Rapid (Texas red oak 7-30 days; Live oak 30-60 days)	Yes	Healthy	Yes	No	No
Oak decline	All oaks	Reduced leaf size and twig die-back in crown of tree	No	Slow (2-8 years)	Unknown	Stressed	Yes	Yes	Yes
Hypoxylon	Post oak, Texas red oak and water oak	Leaves turn brown overall	Retained for a short time	Trees appear thin and yellow for several weeks. In final stage which lasts 1-2 weeks trees go from yellow to brown.	No	Stressed	No	No	Yes



Lichens on small post oak limbs.

suitable sized wood chip at the point of attachment. Chemical treatments have not proven effective.

Ball Moss (Epiphytic plant - *Tillandsia recurvata*)

Ball moss is a plant that grows on many shade trees and causes limbs to die. While it does not derive nourishment from living portions of the tree it smothers developing buds by forming a dense, shading growth on limbs.

Control ball moss with foliar applications of fungicides such as Kocide 101 or Kocide 404. Apply just before an anticipated rainfall. On severely infested trees, a second application may be required in 12 months. When using Kocide avoid drift to nearby sensitive plants and buildings.

Lichens (Combined fungal and algal growth)

Lichens assume several different shapes and colors. They may lay flat on the surface or develop long stringy growths. They vary from gray to a dirty orange in color. It is not uncommon to find several different types on the same limb. Lichens are sometimes indicators of poor growth. They require sunlight to develop and as long as the tree canopy is thick their growth is impeded by shading. Most foliar fungicides will limit their development when or if control is desired.

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